

Bounding calculation of Micro Mirror Array (MMA) scattered light requirements and performance
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1. Assume the following detector possibilities for a canonical 1000s exposure time, based on NGST Detector Committee recommendations for NIR detector noise: viz. Requirement $10e^-/\text{pix}$ and Goal = $3 e^-/\text{pix}$, which correspond to 100 and 9 electrons of detector equivalent "background".
2. Consider the case with NGST-MOS in imaging mode and all MMA mirrors in the OFF state. Basically, this represents the worst possible configuration from the MMA unwanted light contribution (i.e. no reduction in flux due to dispersion by the grating).
3. Following the NGST Detector Committee assumption of 30% spectrometer throughput (including the detector and MMA), the Table below shows the NGST background contribution for a 1000 second exposure in units of electrons per pixel. The pixel size is taken to be $0.05'' \times 0.05''$.
4. The worst case for the MMA spectrometer is strict conservation of photons from the MMA onto the detector array. If the detector and the MMA are arranged to have a 1-to-1 relationship between mirrors and detector pixels, then the total light sent from the MMA into the spectrometer entrance aperture (e.g. the first collimator mirror) is an upper bound on the MMA induced background (it may be lower due to baffling) and dispersion of the background light.
5. The definition of "MMA Contrast" used here is the reduction factor for light impinging on the MMA when the mirrors are set to the OFF position to make the contributions from the detector and the sky equal. This would imply a factor of root 2 increase in the noise over pure detector noise.

Wavelength Interval	Background / Pixel (in 1000 seconds)	MMA Contrast ($10e^-$ detector noise)	MMA Contrast ($3e^-$ detector noise)
1.0 - 2.5 microns	2,689	27	299
2.5 - 5.0 microns	4,889	49	543
1.0 - 5.0 microns	7,578	76	842
0.6 - 5.3 microns	10,311	103	1146

6. Clearly the most demanding requirement occurs for low resolution spectroscopy with a prism covering in one observation an unrealistically broad wavelength range with very good detectors.
7. The crucial question then becomes what MMA Contrast is likely to be achievable. TI digital projectors (MMA like device together with the commercial quality optical system) are specified to deliver contrast exceeding 100:1. We have measurements of the DMD showing results exceeding this by at least a factor of 2.
8. An NGST-MOS MMA may be expected to exhibit considerably higher contrast since the NGST-MOS optical system is at a much slower f number than the TI projector. To create a compact projection system, the TI projectors have fast optics ($<f/3$). NGST-MOS uses $f/24$ at the MMA. Consequently, the fraction of the unwanted light scattered from the MMA and captured by the spectrometer's entrance aperture is reduced considerably. A first order estimate (without a detailed model of the light distribution from the MMA) is that the reduction is proportional to the relative area of the spectrometer entrance apertures. This would represent a factor of 62.7 between $f/3$ and $f/24$.
9. Therefore we estimate that NGST-MOS MMA contrast of 1000 should be easily achievable and contrast approaching 10000 may be possible. These estimates indicate that an MMA will easily provide a suitable contrast for the baseline detector requirement and would still have considerable margin for the "goal" detectors.